HARDWICK MEAT WORKS HEAT PUMP PROJECT

LESSONS LEARNT REPORT NUMBER 1

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This Project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program.

EXECUTIVE SUMMARY

The project involves the installation of a heat pump and its integration with the site's solar and battery storage system. The site's High Voltage ("HV") power also must be upgraded. The HV upgrade will also facilitate more cost-effective installation of any future renewable assets on site particularly if they are to be installed further away from the interface with the grid. It will also allow for more straightforward delivery of excess renewable power back into the network if it is required for future grid demand/ frequency management.

This Lessons Learnt Report covers the works undertaken from 28 February to 29 April 2022. It specifically covers:

- Works related to completion of the engineering and design for the Project;
- Evidence that demonstrates that orders have been placed for the purchase of Major equipment.

ENGINEERING AND DESIGN

Lessons for this phase of the works mainly revolved around the detailed review of the control philosophy for the high temperature heat pump when used in conjunction with existing ammonia refrigeration plant and existing thermal storage tanks. Whilst the sizing of the larger plant assets (i.e. Heat Pump and HV assets had previously been developed during the feasibility phase of the work, the detailed integration and control of the heat pump, refrigeration condenser and water management needed to be finalised.

The key lesson was the importance of developing an accurate Piping and Instrumentation Diagram ("P&ID") and associated functional description so that the new heat pump and oil heat recovery could be effectively integrated into existing tanks and at the same time satisfy the variable hot water demands for the site. The P&ID also allowed us to firm up final sizing of the upgraded recovery hot water systems as well as specification for the new instrumentation and control required for both delivery and inventory management for this hot water.

COMMERCIAL

The initial project management was a challenge due to the relatively long timeframe for the Project approval, impact of Covid and risk of cost variations over that time. Also, consideration as to when the heat pump would be operational had to be factored into recontracting for both future power and gas supply contracts for the site.

The key lesson here was the importance of having flexibility in Project Management and the control of budget estimates prior to project approval. Whilst this applies to any project where new technologies are involved, the HV design and the design of heat pump controls were more complex than expected, and therefore took longer than expected to complete and were more costly than estimated.,

KEY LEARNINGS

LESSONS LEARNT NUMBER 1:

Topic/Category: Commercial

Objective:

Provide a detailed proposal to deliver a Project approval which, in turn, allowed the Project Manager to place orders for the major equipment for the project.

Detail:

The detailed feasibility project work supported by the Australian Alliance for Energy Productivity (A2EP) and funded by ARENA allowed the Project Manager to source firm pricing quotations for the major components on the project (i.e.: heat pump and HV upgrade). This, combined with the cost benefit models and energy balances, allowed the business case approval by the company's management to be streamlined.

The initial project management was a challenge due to the relatively long timeframe for the Project approval, impact of Covid and risk of cost variations over that time. Examples of this were the cost of copper for the HV upgrades and the exchange rate impacts for imported equipment like the heat pump compressors, etc.

Also, consideration as to when the heat pump would be operational had to be factored into recontracting for both future power and gas supply contracts for the site.

The key lessons here were the importance of having flexibility in Project Management and the control of budget estimates prior to project approval.

LESSONS LEARNT NUMBER 2:

Topic/Category: Technical

Objective:

To complete the engineering and design for the Project.

Detail:

The engineering and design work has been completed and is summarised as follows:

1. The requirements for the heat pump and three oil heat recovery exchangers have been specified and orders placed on the equipment suppliers for the same (Compressor, heat exchangers, vessels and ancillary controls). Detailed design for the heat pump and oil heat exchangers integration into the condenser circuit of the existing ammonia refrigeration plant has been completed and the designers have also finalized where the cut-ins are to occur in the main condenser manifolds, heat pump compressor, heat exchanger locations, refrigeration piping modifications required and associated switch gear and control locations, etc.

2. The hydraulic design for the hot water process supply system has been revised and P&ID prepared on required changes to existing plant hot water system. Component lists for hydraulic circuits have been prepared. These include water flow meters, temperature, level and flow transducers, control valves and required communications hardware. Functional description and associated control logic for operation of the heat pump and heat recovery oil coolers have been prepared.
3. Building design works have been completed including all civils and mechanicals. Consulting Engineers have completed Structural design for the plant room.
4. Electrical HV Upgrade Design and Engineering works have been completed by the electrical designer/contractor. Detailed Design has been completed, and HV switchboard ordered. Ammonia Kiosk, and Ammonia Switchboard have also now been ordered. Discussion is ongoing with the network provider on how HV power is going to enter the site and the delineation point. At this stage the network provider has determined that their termination point will be the existing pole. The electrical Low Voltage ("LV") Panel and wiring configuration design has been completed.

Lessons for this phase of the works mainly revolved around the detailed review of the control philosophy for the high temperature heat pump when used in conjunction with existing ammonia refrigeration plant and existing thermal storage tanks. Whilst the sizing of the larger plant assets (i.e: Heat Pump and HV assets) had previously been developed during the feasibility phase of the work, the detailed integration and control of the heat pump, refrigeration condenser and water management needed to be finalised.

The key lesson was the importance on developing an accurate P&ID and associated functional description so that the new heat pump and oil heat recovery could be effectively integrated into existing tanks and at the same time satisfy the variable hot water demands for the site. The P&ID also allowed firming up of final sizing of the upgraded recovery hot water systems as well as specification for the new instrumentation and control required for both delivery and inventory management for this hot water.

IMPLICATIONS FOR FUTURE PROJECTS:

The project is on schedule and there have been no significant surprises at this stage. That said, the following notes may assist other plants to implement this technology.

- The importance of pre-feasibility for heat pump integration prior to developing business cases. This will vary significantly from site to site depending on assets at site. Typically, these include thermal storage capacity available/ required, power infrastructure and options to seamlessly integrate control logic into the existing refrigeration and hot water delivery systems.
- Realisation that installation of new technologies into an existing operational plant will take time so it is important to provide a comprehensive business case including all likely benefits. In addition to the energy cost savings and carbon savings, it should also include all co-benefits associated with the project. In the case of high temperature heat pumps these co benefits could include reduced water consumption, lower condenser fan power, reduced head pressure due to higher condenser capacity available as well as avoided incremental capital for condenser capacity and boilers, etc.

- Importance of involvement of specialist refrigeration suppliers at the commencement of the project as they provide a sounding board on the practicality of retrofitting with the existing assets.

CONCLUSION:

The key lessons learnt from the preliminary phase of the project relate to the process of identifying the most effective options to deliver the business plan and specify control logic for the heat pump operation and its integration into the plant hot water systems.